CLAIMS

We claim:

1. A method of determining the concentration of a substance of interest in a nonwater sample comprising:

exciting the sample with a wavelength of light that is absorbed by the substance of interest;

generating an acoustic wave within the sample;

detecting the acoustic wave; and

determining the amount of the substance of interest present in the sample.

2. The method of claim 1, wherein the substance of interest is present at a concentration less than 1% in the sample.

3. The method of claim 1, wherein the nonwater sample consists essentially of oil.

4. The method of claim 3, wherein the sample is synthetic oil.

5. The method of claim 1, wherein the nonwater sample consists essentially of hydrocarbon-based fuel.

6. The method of claim 1, wherein the nonwater sample is not a biological fluid.

7. The method of claim 1, wherein the substance of interest is water.

8. The method of claim 7, wherein the concentration of water in the sample is less than about 250 ppm.

9. The method of claim 7, wherein the concentration of water in the sample is less than about 100 ppm.

10. The method of claim 7, wherein the concentration of water in the sample is less than about 1%.

11. The method of claim 7, wherein the wavelength of light is between about 2.6 μm and 3.0 μm.

12. The method of claim 1, wherein the light is pulsed or modulated.

13. The method of claim 1, wherein the nonwater sample comprises oil.

14. The method of claim 1, wherein the acoustic wave is detected by a transducer in acoustic communication with the sample.

15. A method of determining the concentration of water in an oil sample which contains less

than 1% water comprising:

exciting the sample with light having a wavelength water absorbs;

generating an acoustic wave within the sample;

detecting the acoustic wave with a transducer in acoustic communication with the sample; and

determining the amount of water present in the sample by processing the signal detected by the transducer.

16. The method of claim 15, wherein the oil sample is synthetic oil.

17. The method of claim 15, wherein the light is pulsed or modulated.

18. A method of determining the concentration of water in a nonwater sample, comprising:

exciting the sample with light having a wavelength which is less than 1 mm;

generating an acoustic wave within the sample;

detecting the acoustic wave with a transducer in acoustic communication with the sample; and determining the amount of water present in the sample by processing the signal detected by the transducer.

19. The method of claim 18, wherein the nonwater sample comprises oil.

20. The method of claim 18, wherein the nonwater sample consists essentially of oil.

21. The method of claim 20, wherein the sample is synthetic oil.

22. The method of claim 18, wherein the nonwater sample consists esentially of hydrocarbon-based fuel.

23. The method of claim 18, wherein the light is pulsed or modulated.

24. An apparatus for determining the concentration of a substance of interest in a nonwater sample comprising:

an excitation source which provides light having a wavelength that is absorbed by water;

a sample in light contact with the excitation source; and

a detector in acoustic communication with the sample.

25. The apparatus of claim 24, wherein the excitation source is a pulsed or modulated source.

26. The apparatus of claim 24, wherein the sample comprises oil.

27. The apparatus of claim 26, wherein said oil is synthetic.

28. The apparatus of claim 24, wherein the sample comprises hydrocarbon-based fuel.

29. The apparatus of claim 24, wherein said detector is a transducer.

30. The apparatus of claim 24, wherein said substance of interest is water.

31. The apparatus of claim 24, wherein said apparatus is located in a flow stream.

32. An apparatus for determining the concentration of water in an oil sample comprising:

an excitation source which provides pulsed or modulated light having a wavelength water absorbs;

a prism cell in light contact with the excitation source; and

a transducer in acoustic communication with the sample.